DEREChOS: Data Environment for Rapid Exploration and Characterization of Organized Systems (DEREChOS)

Completed Technology Project (2015 - 2017)

Project Introduction

Motivation/Problem Statement: DEREChOS is a natural advancement of the existing, highly-successful Automated Event Service (AES) project. AES is an advanced system that facilitates efficient exploration and analysis of Earth science data. While AES is well-suited for the original purpose of searching for phenomena in regularly gridded data (e.g., reanalyses), targeted extensions would enable a much broader class of Earth science investigations to exploit the performance and flexibility of this service. We present a relevancy scenario, Event-based Hydrometeorological Science Data Analysis, which highlights the need for these features that would maximize the potential of DEREChOS for scientific research. Proposed solution: We propose to develop DEREChOS, an extension of AES, that: (1) generalizes the underlying representation to support irregularly spaced observations such as point and swath data, (2) incorporates appropriate re-gridding and interpolation utilities to enable analysis across data from different sources, (3) introduces nonlinear dimensionality reduction (NDR) to facilitate identification of scientific relationships among high-dimensional datasets, and (4) integrates Moving Object Database technology to improve treatment of continuity for the events with coarse representation in time. With these features, DEREChOS will become a powerful environment that is appropriate for a very wide variety of Earth science analysis scenarios. Research strategy: DEREChOS will be created by integrating various separately developed technologies. In most cases this will require some re-implementation to exploit SciDB, the underlying database that has strong support for multidimensional scientific data. Where possible, synthetic data/inputs will be generated to facilitate independent testing of new components. A scientific use case will be used to derive specific interface requirements and to demonstrate integration success. Significance: Freshwater resources are predicted to be a major focus of contention and conflict in the 21st century. Thus, hydrometeorology and hydrology communities are particularly attracted by the superior research productivity through AES, which has been demonstrated for two real-world use cases. This interest is reflected by the participation in DEREChOS of our esteemed collaborators, who include the Project Scientist of NASA SMAP, the Principal Scientist of NOAA MRMS, and lead algorithm developers of NASA GPM. Relevance to the Program Element: This proposal responds to the core AIST program topic: 2.1.3 Data-Centric-Technologies. DEREChOS specifically addresses the request for big data analytics, including tools and techniques for data fusion and data mining, applied to the substantial data and metadata that result from Earth science observation and the use of other data-centric technologies. TRL: Although AES will have achieved an exit TRL of 5 by the start date of this proposed project, DEREChOS will have an entry TRL of 3 due to the new innovations that have not previously been implemented within the underlying SciDB database. We expect that DEREChOS will have an exit TRL of 5 corresponding to an end-to-end test of the full system in a relevant environment.

DEREChOS: Data Environment for Rapid Exploration and Characterization of Organized Systems

Table of Contents

DEREChOS: Data Environment for Rapid Exploration and Characterization of Organized Systems (DEREChOS)
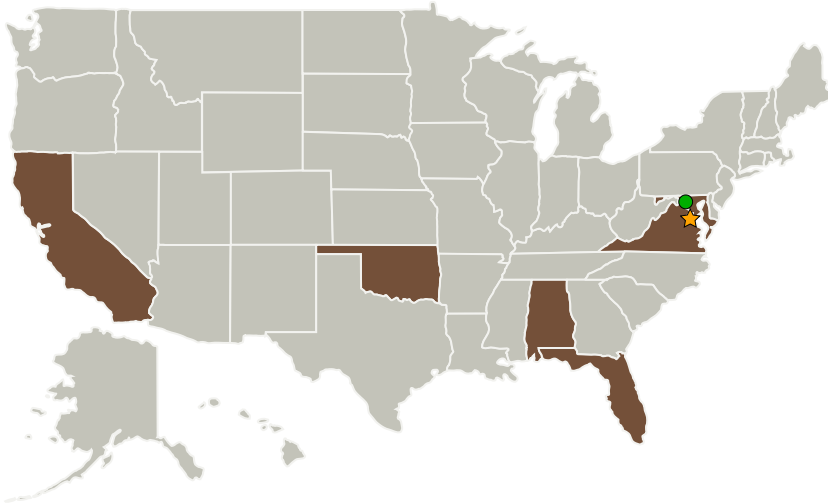
Completed Technology Project (2015 - 2017)

Anticipated Benefits

SMAP

Primary U.S. Work Locations and Key Partners

Organizations Performing Work	Role	Type	Location
⭐NASA Headquarters(HQ)	Lead Organization	NASA Center	Washington, District of Columbia
Bayesics, LLC	Supporting Organization	Industry Small Disadvantaged Business (SDB)	Greenbelt, Maryland
🟢Goddard Space Flight Center(GSFC)	Supporting Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations	
Alabama	California

Organizational Responsibility

Responsible Mission Directorate:
Science Mission Directorate (SMD)

Lead Center / Facility:
NASA Headquarters (HQ)

Responsible Program:
Advanced Information Systems Technology

Project Management

Program Director:
Pamela S Millar

Program Manager:
Jacqueline J Le Moigne

Principal Investigator:
Kwo-sen Kuo

Co-Investigators:
Jian Zhang
Markus P Schneider
Simon H Yueh
Michael L Rilee
Amidu O Oloso
John A Rushing
David T Leisawitz
William S Olson
Gyorgy Fekete
Rahul Ramachandran
Ziad S Haddad
Kwo-sen Kuo
Yudong Tian

Primary U.S. Work Locations *(cont.)*	
Florida	Maryland
Oklahoma	Virginia

Technology Maturity (TRL)

Start: **3**
Current: **3**

1	2	3	4	5	6	7	8	9

Applied Research | Development | Demo & Test
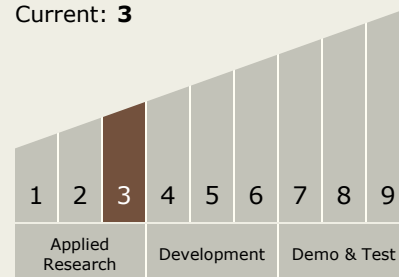
Technology Areas

Primary:

- TX11 Software, Modeling, Simulation, and Information Processing
  └ TX11.4 Information Processing
    └ TX11.4.2 Intelligent Data Understanding

Target Destination
Earth